The description of pp-interactions with very high multiplicity at 70 GeV/c by Two Stage Gluon Model [1]

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Abstract

Collective behaviours of secondary particles in pp - interactions at 70 GeV/c are researched. The Two Stage Gluon Model is supposed for describing of processes with very high multiplicity. It is shown that gluons play the active role in the multiparticle dynamics. Analysis of multiplicity distributions of charged, neutral particles and total multiplicity gives the thermodynamic meaning of these interactions. The mechanism of the soft photon formation as a signature of the quark-gluon system considered.

1 Introduction

These investigations were implemented in frameworks of the project "Termalization". This project directs to researches of collective behaviours of secondary particles in proton-proton interactions at 70 GeV/c [1].

On the basis of the present understanding of hadronic physics, based on quantum chromodynamics (QCD) [2], as the theory of strong interactions, protons consist from quarks and gluons. We construct the two stage gluon model for the description of high energy multiparticle production (MP) in proton interactions. At first stage QCD and thermodynamical approaches are used. At second stage (stage of hadronization) the phenomenological description is applied [3].

After an inelastic collision of two protons the part of the energy of these motive particles are converted into the thermal one. Constituents of proton quarks and gluons will have large energies, and they can be described by perturbative QCD, because the strong coupling reaches a small value. Quarks and gluons become asymptotic free ones. Our model investigations had shown that quark division of initial protons in pp interactions at 70 GeV/c is absent. Multiparticle production is realized by active gluons. These researches

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had confirmed the idea P.Carruthers about a passive role of quarks. He suggested that they are only "labels and sources of colour perturbation in the vacuum: meanwhile the gluons dominates in collisions and multiparticle production " [4].The domination of gluons was first proposed by S. Pokorski and L. Van Hove [5]. It was also noted that the basis for active role of gluons is induced by the existence of three-gluon or four-gluon couplings, and this leads to the cascade of many gluons, which are hadronized [6].

One of the most generally accepted methods for study of multiparticle dynamics is the multiplicity distributions (MD) analysis. Using this method it is possible to known much new about the development of study processes. For this purpose two schemes are supposed. They are distinguished only by quark-gluon (QG) stage. If we want to study gluon division inside QG system (QGS) we use the first scheme (branch model). If we don't interest what is going inside of QGS we use second scheme (thermodynamic model). In both schemes some of gluons (not of all) leave QGS and convert to real hadrons or hadron resonances. We named such gluons active ones. In the thermodynamic idea we can say that active gluons are evaporated from hot QGS. After the evaporation they pass stage of hadronization.

Basic research results were obtained into frameworks of two built schemes for MD of charged and neutral mesons, total multiplicity. The dependence of mean multiplicity of neutral pions from number of charged particles was obtained too. Compared parameters of hadronization for charged and neutral mesons we get the confirmation to the hypothesis of the equal probabilities of presence of quark-antiquark germs of any flower into physical vacuum. Usually this is known as a priori probability.

Processes of pp interactions at 70 GeV/c were investigated experimentally some years ago [7]. MD of charged particles were obtained. These distributions were limited to 20 secondaries. Among them were n charged mesons (π^+ or π^-) and two leading protons:

$$p + p \rightarrow n\pi + 2N. \tag{1}$$

Usually scaling variable $z = n/\overline{n}$ is used, where $\overline{n}$ is the mean multiplicity. For $n = 20$ at 70 Gev/c we have $z = 3.5$. The kinematical limit constitutes to $n_\pi = 69$, where n_π is the number of pions. In present experiment it is planed to get events with multiplicities $n_\pi = 40 - 60$, $z = 5 - 7$. At very high multiplicities (VHMP) and near the threshold of reaction (1) all particles have a small relative momentum and than the large density of hadron system will be reached in the phase space. According to generally accepted conception at these conditions that system should be in QG plasma (QGP) [8] state.

The possible signal for QGP the most commonly proposed ones being prompt production of photons, prompt means that the photons should not be decay products of hadron [9]. The explanation of the experimental increase of the rate of direct soft γ's as the results of the Compton QG scattering in comparison with calculations based on the bremsstrahlung and radiative decays of hadrons is proposed. These photons could give the information about early stage of QG interactions.

We are doing some suggestions on future investigations. These schemes may be applied for the description pp-interactions at the higher energies (102, 205, 303, 405 and 800

GeV/c), others initial particles (π^+, π^-, K^+, K^-, $\overline{p}$ and so on) and nucleus, if we modify our models.

2 Basing for choice of scheme

The choice of MP scheme is based on comparison with experimental data [7]. At the beginning of 90th successful description of MD was realized by quark model [10]. In this model was suggested that one proton quark pair, two pairs or three can to collide and fragment into hadron jets. MD in quark jets were described by Poisson. Second correlation moments of charged particles for MD in this model will be negative always. It is known they are become positive at higher energies. In addition this model doesn't take into account situation when quark pair doesn't scatter but secondary particles are appearing. In this model it wasn't mentioned about gluons too.

Physicists from IHEP (Protvino) used generator PYTHIA, as most applied for many purposes, and obtained MD of charged hadrons [7]. They had shown that PYTHIA don't agree with experimental data at high multiplicities and has the deviation at $z = 3.5$ equal to two orders.

In that way we must build new scheme of hadron interactions for MD description. We want to get agreement for very high multiplicity [1](VHMP) region too. We use the Two Stage Model (TSM) [11] which described MD in e^+e^--annihilation into hadrons from 10 to 200 GeV well. We consider that at the early stage of pp interactions initial quarks and gluons take part in the formation of QGS. They can give branch processes. On this stage (we name her of branch stage) MD for quark and gluon may be described Polya and Farry distributions [12], accordingly. On the second stage (hadronization of quarks and gluons to hadrons) we take binomial distributions [3].

Also as in TSM we use hypothesis of soft colourless for quarks and gluons on the second stage and add stage of hadronization to branch stage by means of factorization

$$P_n(s) = \sum_{m=0} P_m^P(s) P_n^H(m,s), \tag{2}$$

where $P_n(s)$ - resulting MD of hadrons, P_m^P - MD of partons (quarks and gluons), $P_n^H(m,s)$ - MD of hadrons (second stage) from m partons. Generation function (GF) for MD in hadron interactions are determined by convolution of two stages

$$Q(s,z) = \sum_{m=0} P_m^P(s) \left(Q^H(z)\right)^m = Q^P(s, Q^H(z)), \tag{3}$$

$$P_n(s) = \frac{1}{n!}\frac{\partial^n}{\partial z^n}\left(Q^P(s, Q^H(z))\right)\Big|_{z=0},$$

where Q^H and Q^P - GF for MD at hadronization stage and in QGS.

At the beginning researches we took model where some of quarks and gluons from protons take part in the formation of hadron jets. Parameters of that model had values which

were differend a lot from parameters obtained in e^+e^-- annihilation, especially parameters of hadronization. It was one of the main cause for refusal from a scheme with active quarks.

After that we stopped on the model where quarks of protons didn't take part in the creation of jets, but remained into leading particles. All of new hadrons were formed by gluons. We will name these gluons active ones. They could give branch before hadronization. Part of these gluons didn't convert into hadrons and they were of source for soft photons.

Other processes of scattering differ of initial quark content. We think that if at the beginning interaction antiquarks are present side by side with quarks they can as usually annihilate and make additional leading mesons. That behaviour may be observed in proton-antiproton scattering [13].

It's very important to know how much active gluons are into QGS at the first time after the the impact of protons. We can assume that their number may grow from zero and higher. It is analogue of aimed parameter for nucleus. Only in the case of elastic scattering active gluons are absent. The simplest MD for the description of active gluons formed in the moment of impact is Poisson distribution

$$P_k = \frac{e^{-\overline{k}}\overline{k}^k}{k!}, \tag{4}$$

where k and $\overline{k}$ are the number and mean multiplicities of active gluons, accordingly.

3 TSM with branch

We begin our MD analysis with branch scheme of gluons. At the basing of scheme for description of MP it was marked that on the first stage in the moment of impact some active gluons may appear. The energy of colliding protons is transforming into internal energy of QGS. The temperature of this system is raised sharply. According to QCD gluons of protons may become nearly free particles. We use MD (4) for the description of them. These active gluons in QGS have some energy. If their energy is large they may to give branch processes. For the description of MD in gluon jets that formed by branch process of k active gluons we use Farry distribution [12]

$$P_m^B(s) = \frac{1}{\overline{m}^k}\left(1-\frac{1}{\overline{m}}\right)^{m-k} \cdot \frac{(m-1)(m-2)\cdots(m-k+1)}{(k-1)!}, \tag{5}$$

if $k > 1$ and

$$P_m^B(s) = \frac{1}{\overline{m}}\left(1-\frac{1}{\overline{m}}\right)^{m-1}, \tag{6}$$

$if \quad k = 1$, where m and $\overline{m}$ are the number of secondaries gluons and mean multiplicites of them. Expressions (5)-(6) were obtained from GF of one gluon Q_1^B

$$Q_1^B = \frac{z}{\overline{m}}\left[1 - z\left(1-\frac{1}{\overline{m}}\right)\right]^{-1} \tag{7}$$

and from assumption about the independent branch of gluons from each other, so GF for MD (5)- (6)

$$Q_k^B = \frac{z^k}{\overline{m}^k} \left[1 - z \left(1 - \frac{1}{\overline{m}} \right) \right]^{-k} \tag{8}$$

Mean multiplicity $\overline{m}$ is averaged to all gluon jets.

We should mark the case at which $k = 0$ (the impact was elastic and active gluons are absent) resulted MD of hadrons in pp-scattering is equal $P_2(s) = e^{-\overline{k}}$.

On the second stage some of active gluons may leave QGS and transform to real hadrons.We named that gluons evaporated ones. Let us introduce parameter α as the ratio of evaporated gluons, leaving QGS, to all active gluons, which may transform to hadrons. Our binomial distributions for MD of hadrons from evaporated gluons on the stage of hadronization are

$$P_n^H = C_{\alpha m N}^{n-2} \left(\frac{\overline{n}^h}{N} \right)^{n-2} \left(1 - \frac{\overline{n}^h}{N} \right)^{\alpha m N - (n-2)} . \tag{9}$$

$\overline{n}^h$ and N are parameters in this expression. They have the meaning average and maximal possible multiplicity of hadrons from one active gluon on the second stage. In this expression an effect of two leading protons is taking into account, too. GF for MD (9) has form

$$Q_m^H = \left(Q_1^H \right)^{\alpha m} = \left[1 - \frac{\overline{n}^h}{N} (1 - z) \right]^{\alpha m N}, \tag{10}$$

where Q_1^H - GF for MD of one gluon, αm - the number of evaporated gluons and $Q_1^H = \left[1 - \frac{\overline{n}^h}{N} (1 - z) \right]^N$.

MD of gluons on the first stage to finish of branch may be written as

$$P_m^P(s) = \sum_{k=0}^{MK} \frac{e^{-\overline{k}} \overline{k}^k}{k!} \sum_{m=k}^{MG} \frac{1}{\overline{m}^k} \left(1 - \frac{1}{\overline{m}} \right)^{m-k} \cdot \frac{(m-1)(m-2)\dots(m-k+1)}{(k-1)!}. \tag{11}$$

Introducing in (2) expressions (9) and (11) we obtain MD of hadrons in the process of proton-proton scattering in two stage gluon model (TSGM)

$$P_n(s) = \sum_{k=0}^{MK} \frac{e^{-\overline{k}} \overline{k}^k}{k!} \sum_{m=k}^{MG} \frac{1}{\overline{m}^k} \frac{(m-1)(m-2)\dots(m-k+1)}{(k-1)!} \cdot \left(1 - \frac{1}{\overline{m}} \right)^{m-k} C_{\alpha m N}^{n-2} \left(\frac{\overline{n}^h}{N} \right)^{n-2} \left(1 - \frac{\overline{n}^h}{N} \right)^{\alpha m N - (n-2)} . \tag{12}$$

Particular cases (an absent active gluons or one gluon) don't mark in (12). In comparison with experimental data [14] the normalized factor Ω was introduced to (12). Numbers of gluons in sums on k and m were restricted by values MK and MG as maximal possible number of gluons on each stage. We take for comparison data [14] at 69 GeV/c because they are not differ from data at 70 GeV/c [7]. χ^2 in both cases are well about ~ 1 at 70 GeV/c and ~ 10 at 69 GeV/c and parameters are similarly. Values of them from comparison are

$N = 40$ and more, $\quad \overline{m} = 2.61 \pm .08, \quad \alpha = .472 \pm .01,$

$\overline{k} = 2.53 \pm .05, \quad \overline{n}^h = 2.50 \pm .29, \quad \Omega = 4.89 \pm .10$

with $\chi^2 \approx 10$. Values of $MK = 6$ and $MG = 1$ give the best χ^2. So we can conclude that branch processes are absent at this energy and in this QGS. The part of evaporating gluons is equal to 47.2 per cent. Mean multiplicity of hadrons from one active gluon equal 2.5 and maximal possible number of hadrons from gluon equal or more 40. This number looks very much like the number of partons in the glob of cold QG plasma L.Van Hove [15]. If we are fixing parameter of hadronization $\overline{n}^h$ and take it equal to1.63 as it will be obtained in the thermodynamic model further, our parameters will be have values

$N = 40$ and more, $\quad \overline{m} = 2.36 \pm .10, \quad \alpha = .728 \pm .010,$

$\overline{k} = 2.51 \pm .06, \quad \overline{n}^h = 1.63$ (fix.), $\quad \Omega = 2.15 \pm .18$

with $\chi^2 = 2.9$ (see figure 1). At this case we have the part of evaporating gluons is about 73 per cent, others parameters are remained without considerable changes. Effect of the evaporation of part active gluons may describe appearance of soft photons. We will analyze this effect further.

4 Thermodynamic model

In the thermodynamic model without branches appeared in the moment of the impact active gluons may leave QGS and fragment to hadron jets. We consider that evaporated from QGS active gluons have Poisson MD as (4)

$$P_m = \frac{e^{-\overline{m}}\overline{m}^m}{m!},$$

and $\overline{m}$ is the mean multiplicity of that gluons. Using binomial distribution for hadrons from gluons (9) and that idea convolution of two stages (2) we obtain MD of hadrons in pp-collisions in framework two stage thermodynamic model (TSTM)

$$P_n(s) = \sum_{m=0}^{ME} \frac{e^{-\overline{m}}\overline{m}^m}{m!} C_{mN}^{n-2} \left(\frac{\overline{n}^h}{N}\right)^{n-2} \left(1 - \frac{\overline{n}^h}{N}\right)^{mN-(n-2)} \quad (n > 2) \tag{13}$$

($P_2(s) = e^{-\overline{m}}$). Our comparison (13) with experimental data [7, 14] (see figure 2, the point with n=2 was excepted) gives that values of parameters

$N = 4.24 \pm .13, \quad \overline{m} = 2.48 \pm .20, \quad \overline{n}^h = 1.63 \pm .12$

and normalized factor $\Omega = 2$ with $\chi^2 \sim 2$. We are constrained in sum (13) $ME =$

6 (the maximal possible number of evaporated gluons from QGS). The significance of hadronization parameter N at the description of experimental data of e^+e^- annihilation was fined equal to $\sim 4-5$ [3] . We can see that our parameter N obtained in TSMT coincides with this value. Besides both models TSMB and TSTM describe data well.

From TSTM the maximal possible of number charged particles is 26. This quantity is the product of maximal multiplicities active gluons and maximal number of hadrons formed from one gluon $ME \cdot N$. In TSMB we have more hadrons, but with very small probabilities.

It is interesting to get MD for neutral mesons. For this purpose we will take experimental mean multiplicity of π^0's in pp-intaractions at 69 GeV/c. It is equal to $2.57 \pm .13$ [16]. Since the mean multiplicity in this process is calculated as the product of mean number of gluons $\overline{m}$ and hadron parameter $\overline{n}^h$ we can determine parameter of hadronization $\overline{n}_0^h$ for neutral mesons. It's equal to 1.036. We do the simplification on the second stage as in TSM [3] for different particles (equalities of probabilities of the creation of different hadrons)

$$\frac{\overline{n}_{ch}^h}{N_{ch}} \approx \frac{\overline{n}_0^h}{N_0} \approx \frac{\overline{n}_+^h}{N_+} \approx \frac{\overline{n}_-^h}{N_-} \approx \frac{\overline{n}_{tot}^h}{N_{tot}}, \tag{14}$$

were lower indexes ch, 0, +, − and tot determine what this quantity corresponds to a charged particle, π^0, π^+, π^- and for total multiplicity $n_{tot} = n_{ch} + n_0$, accordingly. Parameters of hadronization N for neutral, positive, negative and total multiplicity are determined from knowing according $\overline{n}^h$'s and N_{ch}. MD for neutral mesons π^0's, (π^+'s, π^-'s, total multiplicity) have form (13) and may be easy obtain if they will be normalized to mean multiplicity π^0's (π^+'s, π^-'s, total multiplicity). The mean multiplicities of π^+ or π^- mesons are determined as $(\overline{n}_{ch}(s) - 2)/2$, the total mean multiplicity equal to the sum of charged and neutral mean multiplicities: $\overline{n}_{tot}(s) = \overline{n}_{ch}(s) + \overline{n}_0(s)$. The expression (12) gives analogous results, but we use more parameters). MD for neutral mesons are giving on figure 3. From this distribution we see that the maximal possible number of π^0's from TSTM is equal 16. MD for total multiplicity are giving on figure 4. We see that the maximal possible number of total particles in this case is equal 42. In TSMB the maximal possible number of particles is more but probabilities for them are very small. In TSMB we can study what has happened inside of QGS and outside of it (the evaporation of some active gluons). We should note that data were obtained at $n_{ch} < 20$. In the project Thermalization they want to get events with very high multiplicities $n_{ch} > 20$. It's possible that branch will begin at that ones.

In the conclusion of this section the dependence of the mean multiplicities of neutral mesons versus the number of charged particles will be obtained. With the help of MD for total multiplicity $P_{n_{tot}}(s)$ and take into account of Bayess theorem we have

$$\overline{n}_0(n_{ch}, s) = \frac{\sum\limits_{n=n_1}^{n_2} P_{n_{tot}}(s) \cdot (n - n_{ch})}{\sum\limits_{n=n_1}^{n_2} P_{n_{tot}}(s)}, \tag{15}$$

where $\overline{n}_0(n_{ch}, s)$ - the mean multiplicity of π_0's, n_{ch} - the number of charged particles, $P_{n_{tot}}(s)$ - MD for total multiplicity, n_1 and n_2 are lower and top boundaries for total multiplicity at given number of charged particles n_{ch}. Obtained by TSTM (figures 2-4) MD of charged and neutral secondaries give maximal number for charged $n_{ch} = 26$, neutral $n_0 = 16$ and total $n_{tot} = 42$. There fore we have next limits to $n = n_1$ and $n = n_2$: $n_1 \geq n_{ch}$, $n_2 \leq 16 + n_{ch}$. These restrictions are determined only by conservation laws. Mean multiplicity for these limits has form as figure 5. We can see the big distinction with experimental data [17, 18] at small multiplicities.

The marked improvement will be reached if we decrease top limit at low multiplicities ($n_{ch} \leq 10$) to $n_2 = 2n_{ch}$. That is corresponding to the case, when the maximal number of neutrals is equal to the number of charged, and it is possible double excess neutral mesons over positive (negative) pions. At bigger charged multiplicites this limit is defined of $n_2 = 16 + n_{ch}$ (the maximal possible number of neutrals which can be created). We don't know what is happening at the region of VHMP with $\overline{n}^0(n_{ch})$. On the figure 6 it is shown that multiplicity of neutrals versus n_{ch} when n_2 is taken equal to $2n_{ch}$ at small n_{ch} and $n_2 = 16 + n_{ch}$ at $n_{ch} > 10$. It should be marked that the value of the low limit n_1 is staying almost constant and equal to 0 ($n_{ch} < 16$), 0-1 ($n_{ch} = 16 - 18$) or 1-2 ($n_{ch} > 18$). Such behaviour of n_1 and n_2 in (15) indicates that Centauro events [19] with a large charged particles and practically no accompanying neutrals may be realized in the region of VHMP.

AntiCentauro events with a large number of neutrals and with very small charged must be absent. On the figure 5 it is seeing that the existence of antiCentauro events at small n_{ch} must to give very large mean multiplicity of neutrals that is contradicting experimental data [16]$^-$[18].

5 Soft photons and hypothesis of a priori probability

In two stage model with gluon branch it was shown that several of active gluons are staying inside of hot QGS and don't give hadron jets. What has happened with such gluons at the hadronization? New formed hadrons don't contain of gluon content inside and around themselves. They are catching up small energetic gluons which were free before this time. Gluons have possibility to stick to them. Owing to the large strong coupling on this stage they must adhere to just new formed hadrons (the confinement of gluons). These hot hadrons are excited because they have additional energy at the expense of absorbed gluons. This energy may be thrown down by means of the photon radiation.

The production of photons in particle collisions at high energies has been studied in many experiments from 17 to 1800 GeV [20]. Project Themalization is planning to conduct investigations of low energetic photons with $p_t \leq 0.1 GeV/c$ and $x \leq 0.01$ [21]. Usually such photons are named soft photons (SP). The experimental spectra of SP were obtained. It was shown that measured cross sections of such photons are several times larger than expected from QED inner bremstruhlung. For the explanation the excess of SP phenomenological models were suggested. The most known of them are the glob model of Lichard and Van Hove [15] and the modified soft annihilation model Lichard and Thomson [22].

We want to understand what is the souse of such SP and to estimate the number of them. We consider that in the certain moment of time QGS or exited new hadrons may set in almost equilibrium state on the short or finite time. That's why we will try to use for the description of the massless bosons (gluons and photons) the black body emission spectrum [23]

$$\frac{d\rho(\nu)}{d\nu} = \frac{8\pi}{c^3}\frac{\nu^2}{e^{h\nu/T}-1}, \tag{16}$$

where ν is the energy of photon. These result spectra could help us to calculate the number of SP. It should note that the developing in the real time process of hadron interaction reminds Big Bump [24] one resulting our Universe creation. In the last case the equilibrium between electron-proton and photons breaks at very high temperature when electron-proton recombination and the creation neutral atoms take place. At this stage photons cease to interact with hadrons and begin to expand as relict ones. At the present time we observe the spectrum of relic photons [23].

The gluon density at the deconfinement temperature $T_c \approx 160 - 200$ MeV can be estimated by comparison with relic one

$$\rho_{gl}(T) = 5.479\left(\frac{T}{T_0}\right)\cdot 10^{-37}(fm)^{-3}, \tag{17}$$

where $T_0 \approx 3^o$K - the temperature of contemporary relic photons and $\rho = 5.479 \cdot 10^{-37}(fm)^{-3}$ is the density of them. Gluon densities at the deconfinment temperature $T_c = 160$ or $200 MeV$ are $\rho_{gl}(160) = 0.13(fm)^{-3}$ and $\rho_{gl}(200) = 0.25(fm)^{-3}$. The number of gluons N_{gl} in the hot QGS of size $\sim L^3$, where $L = 20$fm, will be the order of thousands:

$$N_{gl}(160) \sim 1000, \quad N_{gl}(200) \sim 2000.$$

In the case $L \sim 10-19$ fm $N_{gl} \sim 100-900$. We conclude that inside our QGS has a many particles. That system may be described by statistical and thermodynamic methods.

Using the spectral spatial density of relic photons (16) again it is possible to get the number of SP N_γ in the region of size of our system (new formed hadrons). This size must be bigger than one in the gluon case. Dependencies of multiplicities of SP from the energy (the moment p) and the linear size of system (L) are given in Table 1.

Table 1. Multiplicities of soft photons N_γ.

$p, MeV/c$	10	15	20	30
L, fm	N_γ	N_γ	N_γ	N_γ
50	3.96	13	32	107
75	13.36	45	107	361
100	31.68	107	253	855
120	64.87	209	495	1670

If the size of our system about 50 fm and average energy of photons 15-20 MeV/c the number of such SP will be the order of 20.

In the conclusion of this section we will analyse the hypotheses of a priori probabilities. It's assumed that the beginnings different quark pairs from the physical vacuum happen with equal probabilities. We will try to examine it by the example of formation neutral and charge mesons. On the whole at this energy $u\overline{u}$ and $d\overline{d}$ quark pairs may appear. If process of hadronization is begun from the formation one charged meson than the opposite charged meson must form on the force of the low of charge conservation. In the contrary case at the formation of neutral it's not necessary the creation of additional particles. So we can affirm that the number of charged hadrons will be more than neutral ones, or the probability of the creation of charged more than neutral. We can give simple estimate of these probabilities.

Two parameters of hadronization were obtained by TSTM $\overline{n}_{ch}$ and $\overline{n}_0$. In according to this hypothesis (a priory probabilities) MD of π_0's from one gluon jet on the second stage may be described by the binomial distribution

$$P_{n_0} = C_{N_t}^{n_0}(0.5+\delta)^{n_0}(0.5-\delta)^{N_t-n_0}, \tag{18}$$

here N_t - the maximal possible number of mesons formed from gluon, n_0 - the number of neutral mesons among these secondaries (the number of charge mesons $n_c = N_t - n_0$). The probability of creation one pair of charge particles $(\pi^+\pi^-)$ is $p_c = 0.5+\delta$ and the probability for one neutral pion is $p_0 = 0.5-\delta$. The normalized condition is $p_0 + p_c = 1$. From TSTM it was obtained $\overline{n}_{ch} = 1.63$ and $\overline{n}_0 = 1.036$. In accordance with (17) these mean multiplicities for binomial distributions will be equal to next expressions

$$\overline{n}_{ch} = (0.5+\delta)N_t,$$
$$\overline{n}_0 = (0.5-\delta)N_t. \tag{19}$$

The probability of the creation of charge pair is more than the neutral meson one $(\overline{n}_{ch} > \overline{n}_0)$. The decision of (19) gives $N = 2.666$ and $\delta = 0.247$. Than probabilities of creation $p_0 = .253$ and $p_c = 0.747$. The ratio of these values is $p_c/p_0 \sim 3$.

6 Conclusions

The two stage gluon model for the description of pp-interactions with VHMP at 70 GeV/c was supposed. It's shown the important role of active gluons in the formation of new hadrons. MD for charge particles are described well. MD for neutral mesons and total multiplicity are obtained too. The maximal possible number of charge and neutral mesons in these processes is found . The thermodynamic idea of the gluon evaporation are given.

Sources of soft photons is researched, and the number such γ's is calculated by statistical physics methods. The analysis of soft gluons are implemented too. The mechanism of creation neutral and charge mesons are investigated.It is ascertained that Centauro events may be discovered in the region charged VHMP and the existence of antiCentauro events is rejected.

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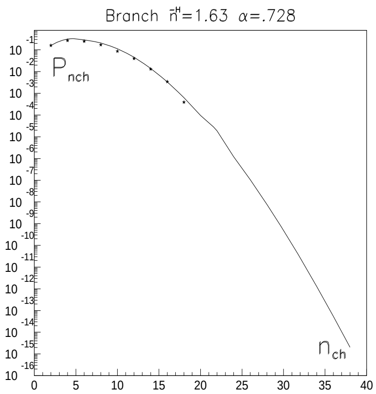

Figure 1: MD $P(n_{ch})$ in TSMB.

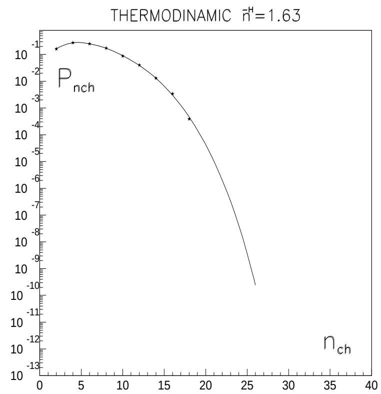

Figure 2: MD $P(n_{ch})$ in TSTM.

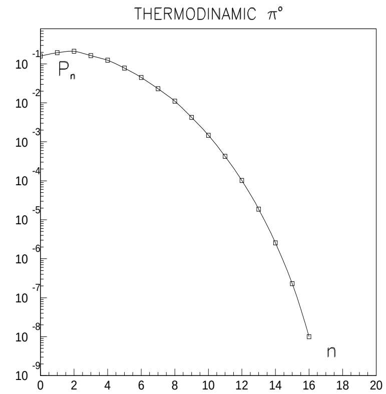

Figure 3: MD $P(n_o)$ in TSTM.

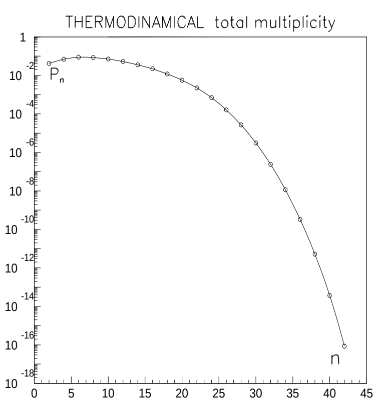

Figure 4: MD $P(n_{tot})$ in TSTM

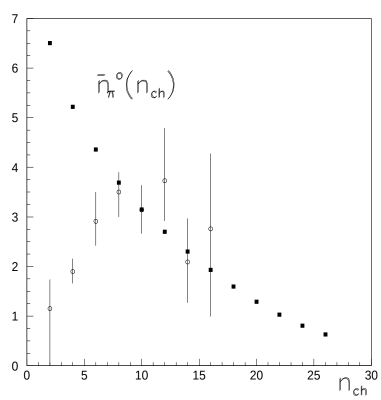

Figure 5: $\overline{n}^o_\pi$ versus n_{ch} (see text).

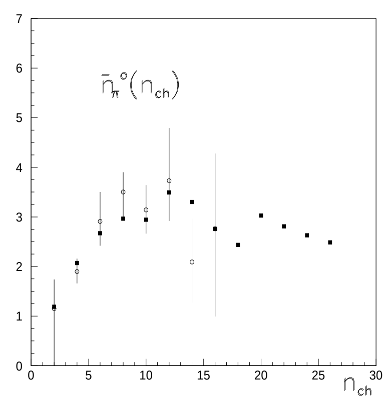

Figure 6: $\overline{n}^o_\pi$ versus n_{ch} (see text).